CORTINARIUS RAPHANOIDES PERS. : FR. AND RELATED SPECIES

by M. MOSER* and H. KELLER-DILITZ**

SUMMARY. — *Cortinarius raphanoides* Pers. : Fr., *C. valgus* Fr. and *C. ochrophyllus* Fr. are studied and redescribed, based on topotypic material and neotypes are proposed. While the first two species belong to *Cortinarius* subgenus *Leprocybe* sect. *Raphanoidei*, *C. ochrophyllus* is unrelated.

RÉSUMÉ. — Études et redescriptions basées sur des matériaux topotypiques sont présentées pour *Cortinarius raphanoides* Pers. : Fr., *C. valgus* Fr. et *C. ochrophyllus* Fr. Des néotypes sont proposés. *C. raphanoides* et *C. valgus* appartiennent au sous-genre *Leprocybe* sect. *Raphanoidei*; pour *C. ochrophyllus* la ressemblance est seulement superficielle.

The interpretation of *Cortinarius raphanoides* Pers. : Fr. varies greatly in literature and this uncertainty can even be found in mycological publications of the last decades. (KÜHNER & ROMAGNESI, 1953; MOSER, 1953, 1970; DENNIS, HORA, ORTON, 1960; ORTON, 1958). Sometimes a *Leprocybe* species from section *Leprocybe*, sometimes from section *Raphanoidei* (= *Brunneotincti* Mos.), sometimes a species which might eventually be a *Dermocybe* is interpreted as *C. raphanoides*. Also the fungus of PERSOON (Syn. 324) and that of FRIES are probably not identical.

Influenced by a Central European tradition the senior author followed the first concept until about 1973/74. The fact however that FRIES says for his fungus : «... *est e vulgatissimis in fagetis sed etiam betuletis Sueciae meridionalis* ...» made him doubt. Having collected fairly much in Southern Sweden

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CRYPTOGAMIE, MYCOLOGIE *(Cryptog., Mycol.)*, TOME 4 (1983).

since 1954 he has never encountered any representative of sect. *Leprocybe* except *C. cotoneus* (or *psittacinus* respectively) in this area.

Checking the collections from the Femsjö area and Southern Sweden for an other possible candidate for *C. raphanoides*, the senior author arrived at the conclusion that only a fungus, which very likely corresponds to *C. raphanoides* in the sense of J.E. LANGE, can be interpreted as *C. raphanoides* in the sense of FRIES. The figure of LANGE however represents no typical specimen.

New collections from Femsjö 1974 were studied thoroughly and colour drawings and slides later compared to the unpublished plate of FRIES. All illustrations looked so similar that they could have been painted from the same collection.

The fungus which agrees fully with all descriptions given by FRIES, is really common, associated with birch but apparently also growing with beech (but birches were intermixed on all habitats).

FRIES stresses on a similarity with *Cort. cinnamomeus*, but this certainly was meant with respect to the shape of the carpophores. The fungus of FRIES can not belong to *Dermocybe* in the present circumscription. The fungus does not contain any anthrachinonic pigments but yellow to blue-green fluoresceing substances. These agree well with those of *C. betuletorum* and *C. vulgus* but are not identical with leprocybin or leprocybosid (may however be chemically related).

MOSER collected in the Femsjö area frequently a fungus named «*pseudo-betuletorum*» in field notes. This fungus agrees well with *Cortinarius vulgus* Fr. FRIES seemingly regarded *C. raphanoides* and *C. vulgus* as closely related as he lists them together.

To judge from macro- and microscopic characters the group is homogeneous and seems fit well within the subgenus *Leprocybe*, representing the section *Raphanoidei* Fr. (= *Brunneotincti* Mos.). *C. betuletorum* is closely related and can grow in the same localities. This similarity seemingly led to some confusion (ORTON, 1958) and HOILAND (1980) following MOSER's concept of *C. raphanoides* (MOSER, 1978) thought the two species to be identical.

Detailed descriptions are given below and neotypes from the Femsjö area proposed.

CORTINARIUS RAPHANOIDES PERS. : FR.

Agaricus raphanoides Pers. : Fr., *Systema* p. 230, 1821.

Neotype (design. mihi) 74/434, Flahult forest, Femsjö, Smoland, Sweden, with *Betula* and *Picea* (and *Fagus*), 1974-09-17, leg. M. MOSER (S, Isoneotyp IB).

Selected illustrations and descriptions : FRIES unpublished plate, herb. Stockholm, J.E. LANGE, *Fl. Ag. Dan.* III. p. 30, p. 96 A? not a typical specimen).

HOILAND 1980, *Norw. J. Bot.* 27, (2), 101 ff.

Cap 2-5,5 cm, obtusely umbonate to convex, often with a permanent slight umbo, margin incurved, surface silkly, smooth, sometimes becoming fibrillose and lacerate or finely squamulose towards the margin in older fruitbodies; colours olive brown (R XXX Isabell Colour when young, XXIX Saccardo's Umber in older fruitbodies), centre often dark brown (R XV Prout's Brown, M 6E6), paler brown with olivaceous tint (about dull XV Buckthorn Brown) when dry, with a more fulvous brown tint in older caps (about Ochraceous Tawny, centre Cinnamon Brown) covered by some paler olivaceous brown fibrils from the veil.

Gills olivaceous brown (R Buckthorn Brown), than more rust coloured (between Ochraceous Tawny and Tawny), relatively thick, distant, L ca 43-48, l = 3, edge uneven, 3-6-(9) mm broad, emarginate to adnate.

Stem 2-7-(8) cm/5-8 mm, exceptionally up to 16 mm thick, cylindric or slightly enlarged towards the base, apex pale with an olivaceous hue (R XXX Cream Buff with slight olive hue), covered by a pale olive brown (Isabell Color) veil below the cortina and forming several wooly belts, older fruitbodies darker olive brown towards the base. Relatively stiff when young.

Context in humid state aqueous olivaceous umber (Saccardo's Brown in cap, somewhat grayish in apex of stem, pale olivaceous brown (Isabell Color) downwards).

Smell of radish, strongly so when cut.

Taste radish like.

Microscopical characters.

Spores broadly elliptic, more rarely broadly subamygdaliform or nearly globose, verrucose, 7-8,8/5-6μm, average 8.08/5.4μm, Q = 1.49.

Hyphae of the cuticule ± radially arranged, 8-12-20μm thick with relatively short segments (60-100μm), walls brownish, with clamp connections (± typical *Leprocybe* type).

Gill edge with clavate to sublageniform sterile cells, sometimes with a short appendice, 28-30/10-11μm.

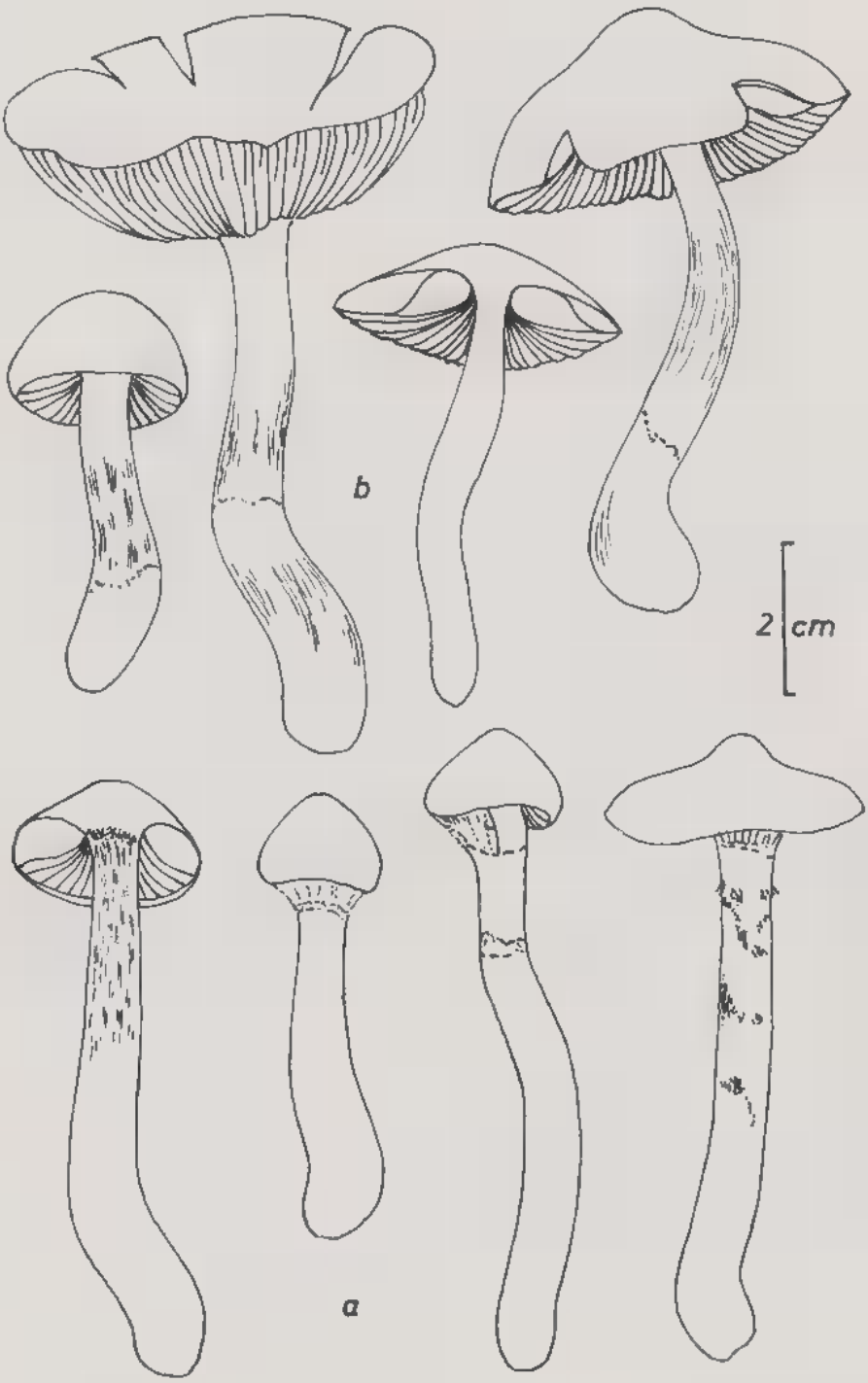
Basidia 4-spored, 28-33/8-10μm.

Hyphae of the cortina 5-6μm, hyalin, those of the universal veil 7-10μm with brownish walls.

Fluorescence : fragments of gills in 2 % KOH show a yellow fluorescence under fluorescence microscope, but not tissues from other parts of the carpophore.

Habitat : with *Betula*, more rarely with beech.

Material : Sweden : 74/299, Femsjö, Hägnan, 74/434 Femsjö, Flahults Skog, 74/502 Femsjö, Södra Saraböke, 78/167 Femsjö Hägnan, 79/340 Femsjö, Lilla Hjortsjö, 81/201 Abisko.
Finland : 78/335 Puutanoja, North of Oulanka, Kuusamo.
France : Rehhof, Alsace.
Austria : 82/311 Naunzalm, Kellerjoch, Tyrol.



USA : Alaska 80/186 South of Anchorage.

Observations : *C. raphanoides* is most closely related to *C. betuletorum* Mos. (MOSER, 1964). The latter has no particular sm ll even when bruised or cut. Apart from that in *C. betuletorum* the colours of the cap are more brown dominated, often darker until umber, the stem is more or less brown all over whereas in *C. raphanoides* the ground colour of the stem is fairly pale at least in young fruitbodies. Typical specimens of *C. raphanoides* have a more or less cylindric stem (shape of *Dermocybe*!) whereas in *C. betuletorum* the stem is often more robust and typically clavate, the base can reach up to 25 mm. The distinction however is not absolutely constant. Spores show no significant difference in size and shape.

CORTINARIUS VALGUS FR.

FRIESE., *Epicrisis*, p. 290, 1836.

Neotype (design. mihi) 70/190 Femsjö, Hägnan, Smoland, Sweden, 1970-09-12 (S, Isoneotyp 1B).

Selected illustrations and descriptions : FRIES unpubl. plate, herb. Stockholm. - Fries, *Hym. Sueciae* II, 69, 1851.

Cap 2-8,5 cm, convex, rarely campanulate, often with broad umbo, than flattened and sometimes depressed, margin sometimes undulate, hygrophanous, dark to pale fuscous, sometimes spotted or zonate (R XV Prout's Brown, XXIX Snuff Brown, Tawny Olive to Clay Color) with a slight olivaceous flush, drying argilaceous to ochraceous- hazel (Seg. ca. (203), 193, R Clay Color and paler) with disc more reddish brown. Surface smooth, silky and often with somewhat atomate sheen or finely marbled when dry.

Gills gray with lilac hue (R XL VI Drab Gray to Light Drab), soon becoming yellowish rusty (Clay Color), edge slightly eroded and whitish fimbriate when young, sub-distant (L = 28-35, l = 5-7), 6-8 mm broad (= 4-5 times context of pileus), deeply emarginate to adnate.

Stem 4,5-9-(10) cm long, (3)-4-8 mm thick at apex, 6-10-(12) mm at the base, cylindric to somewhat clavate, apex grayish blue, then grayish in young carpophores, ochraceous to brownish and silvery striate downwards, often (but not in all carpophores) with an (olivaceous) ochre brownish or paler fuscous zone from veil, sometimes even peronately sheathed but the veil often fugacious and disappearing, base white from mycelium, the stem also with an olivaceous flush in older fruitbodies. Stuffed, then hollow.

Fig. 1. - a: Fruitbodies of *Cortinarius raphanoides* Pers. : Fr.; b: Fruitbodies of *Cortinarius valgus* Fr.

Context pale brownish in cap and stem, darker brown when wet, in apex often bluish or grayish, in the cortex darker brown. No particular smell and taste.

Microscopic characters :

Spores elliptic to broadly elliptic, coarsely verrucose, particularly in the apical part, 7.5-9.5/5.5-6.2-6.5µm, average 8.2/5.3µm, Q = 1.55.

Basidia 4-spored 30-32/8-8.5µm.

Cheilocystidia often frequent, claviform to inflated, 25-40/10-12-15µm.

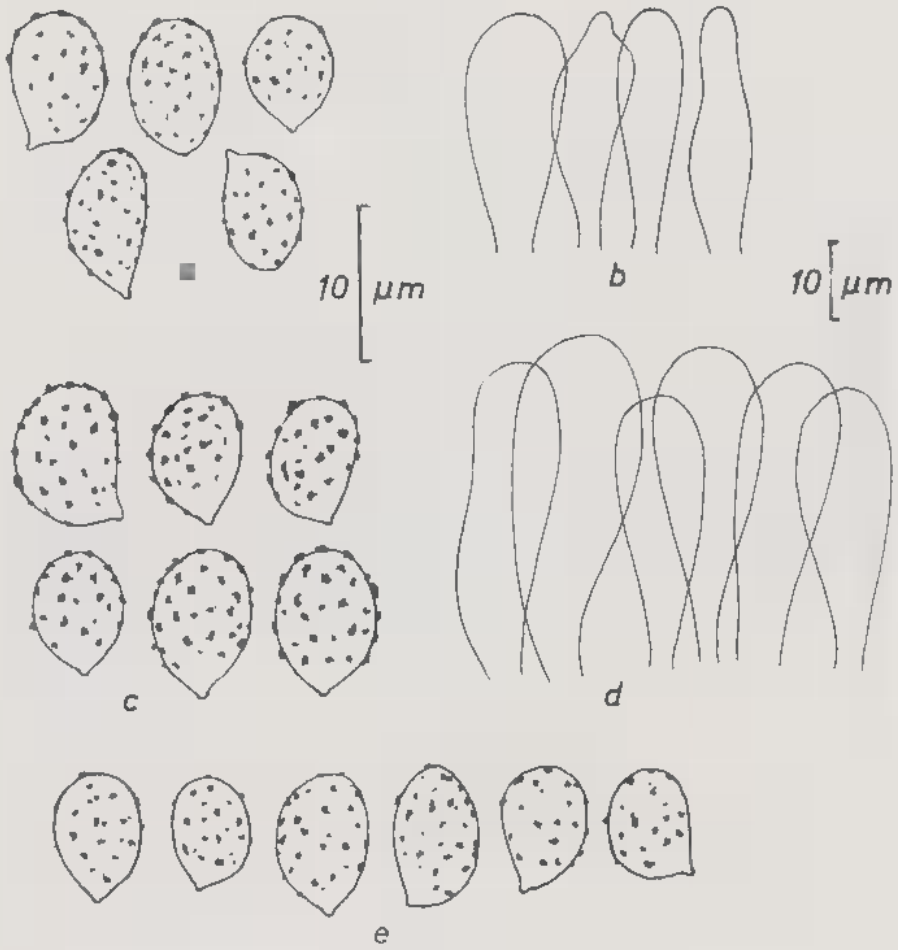


Fig. 2 . – a: Spores of *Cortinarius raphanoides*; b: Cheilocystidia of *Cort. raphanoides*; c: Spores of *Cort. valgus*; d: Cheilocystidia of *Cort. valgus*; e: Spores of *Cort. ochrophyllus*.

Hyphae of the cuticule 6-10μm thick, with brown, sometimes incrusted wall, with clamp connections. Hyphae of the veil (3)-5-7μm, some hyphae of the veil may cover the epicutis.

Trama of pileus ± irregular.

Habitat : Under birch and beech, more rarely in coniferous forests (spruce) and then always intermixed with deciduous trees. On more or less acid soils.

Material : 70/208 Femsjö, North western part, under *Fagus* and *Betula*. 70/190 (Neotype) Femsjö, Hägnan, Southern part *(Fagus, Betula)*; 80/305 Söderåsen South-east of Skäralid, Skåne, under *Fagus*; 81/225 Norrbotten : Abiskojaure, *Betula nana*.
Austria : 82/199 Angerberg near Breitenbach, Tyrol, in spruce forest (but a single *Populus tremula* close to the stand).
Poland : 67/185 Bialowiecza, Podcierkow, under *Betula* and *Picea*.
GRF : 72/306 Bavarian Forest, Grosser Arbersee, deciduous forest.

Observations : The smooth, more or less silky cap and the bluish tints of the apex of the stem are very characteristic. In the gills the bluish gray tint in young carpophores is fugacious – even FRIES does not mention it. The same holds true for the veil.

The chromatographic analysis reveals some compounds which are identical with those of *C. raphanoides*, while some others are lacking.

A further species should be compared with the *Raphanoidei* i. e. *Cortinarius ochrophyllus* Fr., a species not uncommon in the Femsjö area, possibly also associated with birch and having an ochraceous veil. From microscopic characters, particularly structure of subcutis and spore shape the species could belong to the *Anomali*. However the type of veil and the colours of the fruitbodies could also suggest a *Leprocybe* of the sect. *Raphanoidei*. The shape of spores would not oppose this. Contrary the chromatographic analysis excludes it from the *Raphanoidei*.

CORTINARIUS OCHROPHYLLUS FR.

Vet. Ac. Förhandl. 1861 – *Monogr. Hym. Suec.* vol. II, 308. 1863.

Neotype (design. mihi) 79/265, Kyrkemosse, Femsjö, (S, isoneotyp IB).

Icones : FRIES, unpubl. plate, herb. Stockholm.

Cap 2.5-6 cm, from conical to campanulate or convex and umbonate or semiglobose to convex and flattened, sometimes margin inflexed, only slightly hygrophanous, relatively bright ochraceous brown even when young and humid (Expo 63 C) to grayish brown (R ca. XXIX Tawny Olive) or sometimes near Snuff Brown or Expo 54 E, 52 F in older carpophores, darker spots may also occur on younger fruitbodies, margin about Ex 63 C, in dry condition ochraceous brown to yellow brown (Ex 66 C-66 B, R XXIX Clay Color to Cinnamon

Buff on disc). Surface finely fibrillose, tomentose, particularly in the marginal part, not or only slightly atomate silky (as in typical *Anomali*).

Gills grayish brown (R XV Ochraceous Tawny, XXIX Clay Color), rust coloured when older (Expo 58 E) or occasionally darker (III Amber brown), deeply sinuate, edge eroded, ventricose, 5-9 mm broad, slightly distant, L = ca. 40, l = 3-5.

Stem cylindric to slightly clavate, 4-9-14/5-12, base 7-14 mm, pale argillaceous-ochraceous, sometimes nearly whitish (Ex 61 A, 72 A to 72 B), below the cortina covered by a floccose ochraceous veil in young fruitbodies (present in all carpophores but sometimes only weakly).

Context dirty brownish to pale watery umber when humid, pale to nearly whitish when dry.

Smell unconspicuous, **taste** mild.

Microscopic characters :

Spores broadly elliptic to subglobose, 7,5-8/5.5-6,2µm, average 7.8/5.5µm, Q = 1,41, punctate to slightly verrucose.

Basidia 4-spored, 30-35/9-10µm, sterigmata 3-4µm.

Gill edge fertile, no cheilocystidia observed.

Epicutis relatively thin, 60-70µm thick, hyphae 9-11µm thick, with clamp connections.

Subcutis made up from subcellular elements (20-30µm thick, segments 30-70µm long).

Habitat : All recolts from coniferous forests *(Picea)* mixed with *Betula* (so eventually the fungus might be associated with *Betula*), on acid soils.

Material : Sweden : 79/265 (neotyp), Kyrkemosse, Femsjö, under *Betula* in mixed forest, 1979-08-10, leg. M. MOSER; 57/22, Ulfhult, Femsjö; 57/52 3 km South of Bygget, Halland, 1961-07-17 Dröpplastigen, Femsjö; 72/210 Dröpplastigen, Femsjö; 72/223, Lilla Kulkagöl, Femsjö; 79/471, South of Yaberg, Femsjö.
Norway : 81/356 Rinilhaugen, Öståsen, Lunner, Oppland.

Chemotaxonomic Investigations in the Section *Raphanoidei*

Ethanolic extracts of nine collections of the species *C. raphanoides* Pers. : Fr., *C. betuletorum* (Mos.) Mos. and *C. valgus* Fr. were examined by means of Thin Layer Chromatography (TLC) using silica layers (Silicagel Merck 60, Silica Woelm) and five different solvent systems (KELLER-DILITZ, ined.).

Two types of compounds were detected in these species. All collections are characterized by light yellow fractions exhibiting an intensive green fluorescence in UV-light (λ = 366 nm). These fluorescent compounds seem to be specific to the *Raphanoidei*-group and are not identical with leprocybin or leprocybosid, which are found in species of the section *Leprocybe*.

Number of fraction	Rf-values in system II	Color of compounds in daylight	Color of compounds under UV-light	Intensity of fractions under UV-light								
				C. raphanoides		C. betuletorum					C. valgus	
				79/30	30/186	63/666	70/207	79/5	76/340	64/194	70/208	70/6
7	0,39	yellow to light brown	dark	-	-	-	-	+	-	-	-	-
6	0,32	red	dark	-	-	-	-	++	-	-	-	-
5	0,59	yellow to light brown	dark	+	+	+	+	+	-	-	-	-
4	0,59	yellow to light brown	dark	+	+	++	++	+++	-	-	-	-
3	0,29	yellowish	green	++	+	+	++	-	++	(+)	+	+
2	0,27	yellow	green	++++	+	+	++	-	++	-	-	+
1	0,21	yellowish	green	++	+	+	++	+	++	+	+	+

Table 1. Distribution of green fluorescent compounds and further characteristic fractions in collections of C. raphanoides, C. betuletorum and C. valgus.

Furthermore, yellow pigments which become brownish on the TLC-plates after a short time can be detected in five of the nine collections tested. They are visible as dark fractions in UV-light and have similar chromatographic properties like dimeric anthrachinoid pigments but no identification was possible by cochromatography with several reference samples.

A chemotaxonomic differentiation on species-level is difficult because considerable qualitative and quantitative variations of the compounds within the various collections are detectable.

However, from the results presented in Table I (Solvent system II: Acetic ether: methanol: water 100:16,5:13,5) is obvious that the nine collections exhibit corresponding chromatograms and therefore the *Raphanoidei*-group is a chemotaxonomic homogeneous one, the fractions one to three being characteristic for all three species, whereas fraction 4 and 5 have not been found in *C. valgus*. (Tab. 1). Two collections of *C. ochrophyllus* Fr. (72/210 and 75/265) were compared chromatographically with the above species in solvent system III (benzene: ethyl format: formic acid 65:25:10). No distinct fractions can be detected in natural light. Under UV some fractions with blue and one with violet fluorescence can be recognized, which however do not correspond to any fractions of the *Raphanoidei*.

LITERATURE

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Colour Codes :

Expo : Cailleux A. et Taylor G., Code Expolaire, 1st edit.;
M = Methuen Handbook of Colour;
R = Ridgway, Color Standards;
Seg. = Séguy, Code Universel des Couleurs.